Controlling Nematodes in the Home Garden

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Precautions

All the fumigants mentioned herein are inflammable; strict precautions should be taken to avoid igniting the fumes. All soil fumigants are toxic to human beings and animals, but none are dangerous to the operator when properly handled. Avoid prolonged breathing of the fumes, even though they may not be irritating or have a distinctive odor. Do not allow the liquids to remain in contact with the skin. Wash off promptly and leave exposed area open to the air for a short time. If the liquids are spilled on clothing, including shoes or gloves, remove the garment without delay. Usually it is not advisable to wear gloves. Never, under any circumstance, take the risk of getting the liquids into the eyes or mouth.

Fumigants are corrosive to metals, especially mixtures containing dichloropropene; hence, applicators should be emptied immediately after use and flushed with a mixture composed of about equal parts of lubricating oil and kerosene.

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CONTROLLING NEMATODES IN THE HOME GARDEN

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Contents

NEMATODES, or eelworms, although they include some of our most serious agricultural pests, are a group of organisms little known to most gardeners. These minute animals, usually slender and wormlike in shape, are too small to be seen easily with the naked eye. Out of thousands of different kinds of nematodes, about 50 are known that injure plants. Some penetrate into the tissue, others feed from the outside. Roots, tubers, rhizomes, and other structures that grow below ground are the parts of the plant most commonly injured, but there are also nematodes that invade the stems, leaves, and buds.

Not all of the nematodes that injure plants occur in the United States; of those that do occur here some are restricted to certain regions or to certain crops. Several of our most serious nematode problems concern crops grown in cool climates, but, in general, the over-all damage caused by nematodes is greater in the South than it is in the North. The likelihood that a garden will be affected by these pests and the extent of the damage that they will inflict depend on the part of the country in which the garden is located and the kind of crops grown. Some of the most important parasitic nematodes likely to injure fruits, vegetables, and ornamentals ordinarily grown in home gardens are the root-knot nematode, the stubby-root nematode, the sting nematode, and the strawberry-dwarf nematodes.

ROOT KNOT

Root-knot nematodes (*Meloidogyne* spp.), of which there are several species, are hot-weather parasites and are favored by short, mild winters, long, hot summers, and light sandy soils. The newly hatched young, or larvae, penetrate into the roots and other parts of the plant that grow below ground and usually stimulate the development of swellings, or galls. On some plants, such as tomatoes and cucumbers (fig. 1), these galls may become large and conspicuous, but on others,

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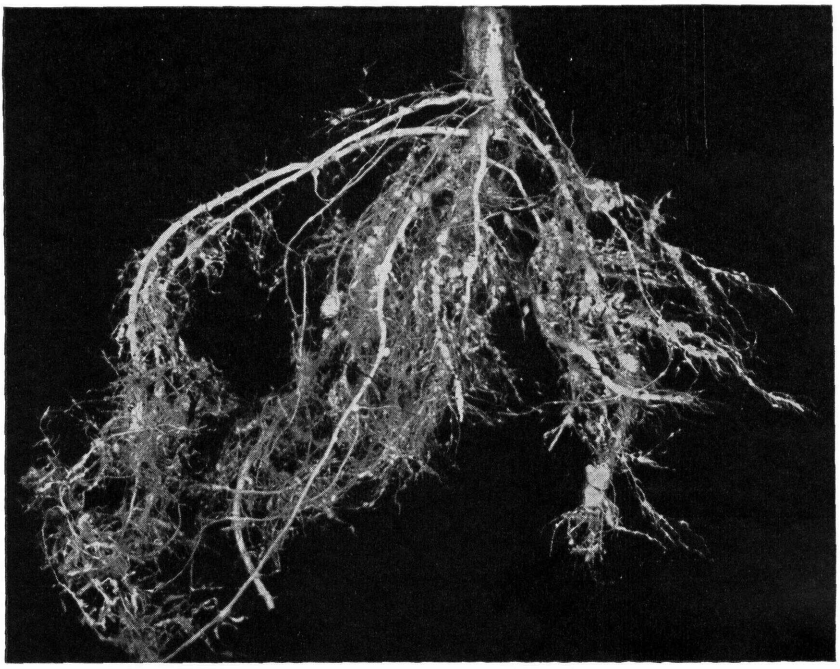

Figure 1.—Roots of a cucumber plant infected with one of the root-knot nematodes.

such as sweetpotatoes, they usually remain small and inconspicuous. The female parasite, after entering a root and becoming established within the tissues, remains in this position throughout the rest of its life and gradually loses its slender form, becoming more or less pear-shaped. Each female lays from 500 to 1,000 eggs that usually accumulate in masses near the surface of the root. During hot weather the complete life cycle is passed in about 30 days.

Nearly all of our common vegetables are susceptible to root knot, but some are more resistant or more tolerant than others. Highly susceptible crops likely to be severely injured include cucurbits of all kinds (cucumbers, squash, muskmelons), tomatoes, beets, beans, lima beans, peas, parsnips, carrots, and okra. Crops somewhat more resistant or tolerant, though by no means immune, include the brassicas (cabbage, cauliflower, turnips, mustard), lettuce, endive, sweet corn, potatoes, sweetpotatoes, and onions.

Efforts are being made to develop root-knot-resistant varieties of vegetables, but as yet few are available. Alabama No. 1 is a root-knot-resistant pole bean of good quality that should be satisfactory for southern gardens. The Nemagreen variety of lima bean is resistant to root knot and will produce a normal crop in locations where ordinary varieties of lima beans fail.

Strawberries are somewhat susceptible to root knot, but usually they are not seriously injured by it. Raspberries and blackberries are resistant. Asparagus is resistant, but rhubarb is susceptible. Apple, pear, plum, and cherry trees are resistant, but peach and fig trees are susceptible and may be severely injured.

CONTROL.—Plants differ markedly in the degree to which they are injured by root knot, and the presence of galls on the roots does not necessarily mean that the crop will be a failure. Unless acquired while the plants are small, a moderately severe infestation may not seriously retard growth or reduce yields under good growing conditions, including ample fertility and moisture. By incorporating into the soil large quantities of organic matter, the severity of the infestation may be reduced, and growing conditions will be provided in which the plants are better able to grow despite the disease.

Wherever possible, rotation should be practiced, at least to the extent that highly susceptible crops are not grown repeatedly in the same place. When cover crops are planted, such root-knot-resistant ones as oats, crotalaria, or hairy indigo should be used. An excellent practice is to divide a piece of land; use half for the garden and half for a henyard, and interchange the positions every year or two. Where such cultural practices cannot be followed or where they prove inadequate, one must resort to nematocides (p. 6).

STUBBY ROOT

Stubby-root nematodes (*Trichodorus* spp.) occur as far north as Maryland and Indiana, but the damage they inflict on crops is greatest in the deep South. They are small creatures that feed at the root tips without entering the tissues. Sometimes the root tip turns brown and sometimes there is little or no discoloration, but in either case the tip stops growing. Lateral roots form and the tips of these, in turn, may be attacked, eventually resulting in a small, compact root system composed of numerous short stubby branches (fig. 2). Deep

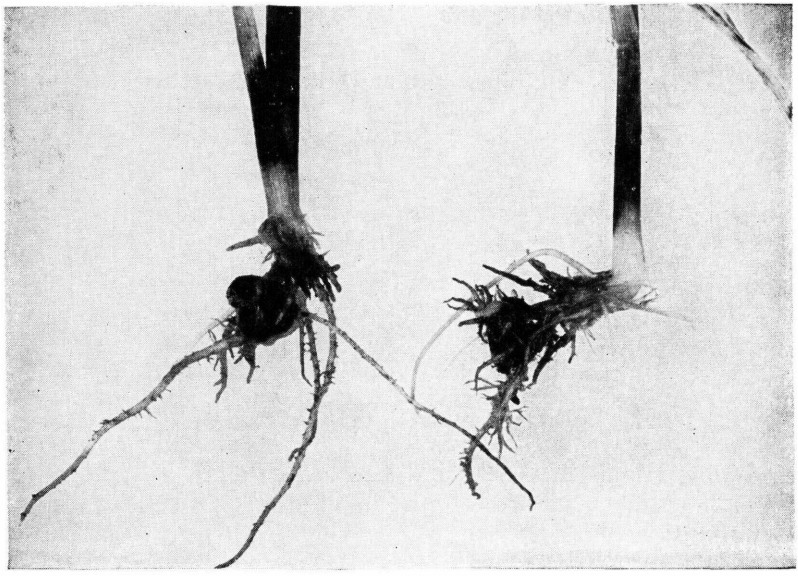

Figure 2.—Roots of young corn plants injured by one of the stubby-root nematodes.

lesions or dead roots do not occur, at least during early stages of the disease, and swellings or galls do not develop. The plant, deprived of a normally functioning root system, is stunted, shows symptoms of starvation, and wilts easily in the sun, even though the soil may have ample fertility and moisture.

Crops that may be severely injured by stubby root include sweet corn, tomatoes, lima beans, celery, and chayotes. Crops that may be definitely injured but, on the whole, are somewhat more tolerant are squash, beans, cucumbers, cabbage, and cauliflower. Crops that appear to escape injury or are injured only slightly include strawberries, lettuce, and endive.

CONTROL.—In some sections of the South, soil where Bermuda grass grows is invariably infested with a species of stubby-root nematode; hence, it is advisable to keep this grass out of the garden. The soil population of this pest can be reduced substantially by dry tillage. Plow or spade the garden 2 or 3 weeks before planting, and, during the intervening period, harrow or stir the soil once or twice or, better yet, plow again just before planting. Rain, however, will reduce the effectiveness of this procedure. Nematocides are only moderately effective in controlling stubby root, because the nematodes are not eradicated and populations build up quickly. Applying nematocides only in the rows or hills where the plants are to grow does not give satisfactory control of these pests.

STING NEMATODE INJURY

The sting nematode (*Belonolaimus gracilis*) is known to injure crops in Florida and Virginia and probably occurs throughout the South. It is a long, slender nematode that feeds at the root tips and along the sides of the roots, mostly from the outside, but it occasionally penetrates the root tissues. When it feeds at the root tips, the effect is much the same as that of the stubby-root nematode and short, stubby branches result. The sting nematode also produces discolored areas, or lesions, along the sides of the roots (fig. 3). Crops known to be injured by this parasite, some of them seriously, include strawberries, sweet corn, celery, beans, cowpeas, beets, and peanuts.

CONTROL.—Little is known about the habits of the sting nematode or about its natural hosts. No suggestions, therefore, can be made for its control by cultural practices. Good control has been obtained by using nematocides.

STRAWBERRY DWARF, OR STRAWBERRY CRIMP

Strawberry-dwarf nematodes (*Aphelenchoides fragariae* and *A. besseyi*) live in the buds of strawberry plants and feed on the young developing leaves. When these leaves unfold they are small, distorted, crinkled, and abnormally dark green (fig. 4). The parasites may be carried in the buds at the ends of the runners. Because it is from these buds that new plants are formed, most of those produced by an infected mother plant are likely to become infected. Two species of these nematodes occur on strawberries: One causes the disease known

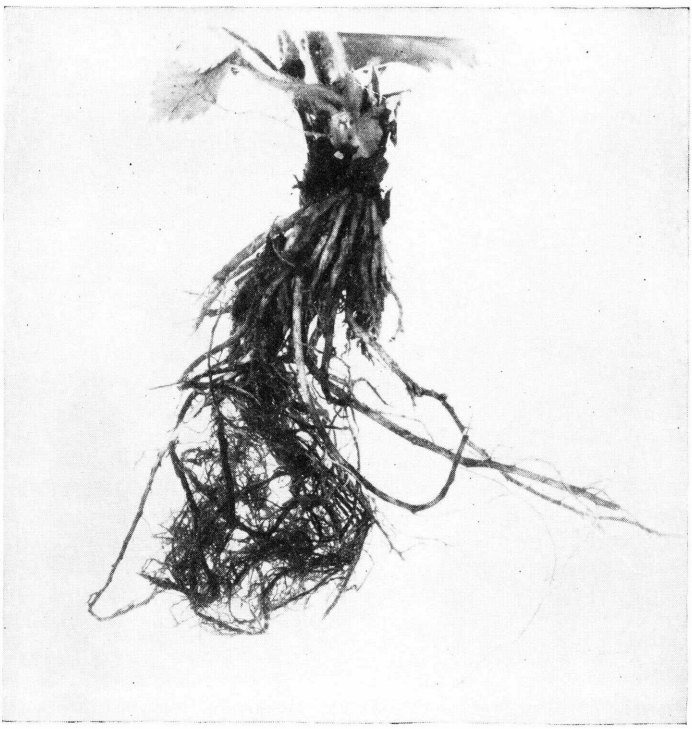

Figure 3.—Roots of a strawberry plant injured by the sting nematode.

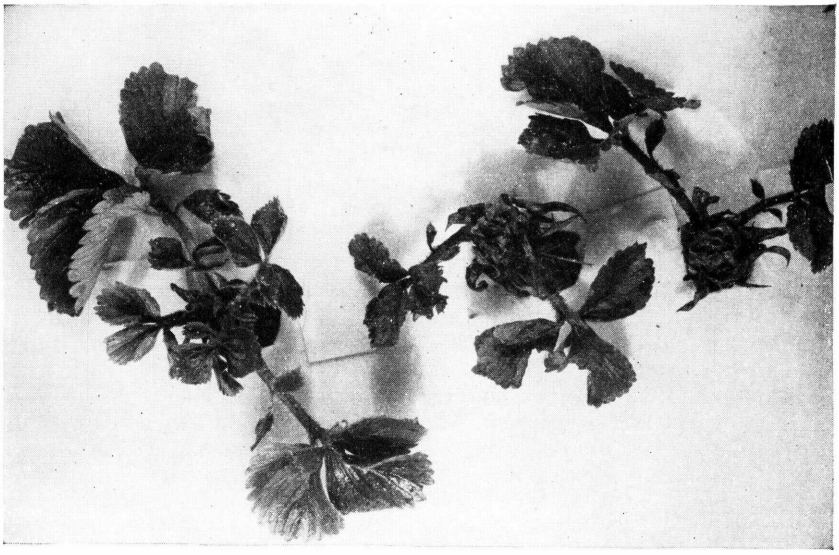

Figure 4.—Spring dwarf of strawberries, caused by one of the strawberry-bud nematodes.

as spring dwarf; and the other causes the disease known as summer dwarf.

Spring dwarf occurs along the Atlantic coast from Cape Cod to the Delmarva Peninsula. It is a cool-weather disease and, as its name implies, it appears in spring soon after the plants start to grow. By the middle or latter part of May the symptoms begin to disappear or are masked by the development of normal foliage. Infected plants produce little or no fruit.

Summer dwarf occurs from the Delmarva Peninsula to Florida and westward to Louisiana and southern Illinois. It is a hot-weather disease. Symptoms appear in midsummer, the exact time depending on climatic conditions, and disappear with the beginning of cool fall weather.

CONTROL.—Almost invariably strawberry dwarf of either type is acquired by setting infected plants, though infection can come from nematodes remaining for some months in soil where infected plants have grown. Once the plants are set and symptoms appear, not much can be done except to ignore the trouble and to harvest whatever crop is produced. Pulling out infected plants as soon as symptoms appear and removing these plants from the bed may help to some extent in preventing spread of the disease. Plants from beds where these diseases occur should never be used for setting new beds. The spring-dwarf nematode does not persist in the soil very long, but where summer dwarf occurs it is advisable to wait at least a year before again planting strawberries in the same place.

NEMATOCIDES

Nematocides are chemicals used to kill nematodes in the soil. Some give off gases after application to the soil and are called soil fumigants. The most widely used of these contain either dichloropropene, ethylene dibromide, or dibromochloropropane and are available in various formulations as liquids, granules, or capsules. Other kinds of nematocides are applied as drenches. One of these contains 0-2,4-dichlorophenyl 0,0-diethyl phosphorothioate. Undoubtedly, other nematocides will be available to the home gardener in the future.

Soil Fumigants

Gases from soil fumigants diffuse through the soil killing nematodes which are in the soil at the time of application. Because the gases diffuse only short distances, the nematocides are applied at closely spaced intervals. Because nematocides are poisonous to plants at the time of application they must be applied before planting. After sufficient time has elapsed, they become harmless.

PREPARING THE LAND.—Before the fumigant is applied, the land should be prepared to the consistency of a good seedbed. Roots of preceding vegetation should be removed, if they have not had time to decay. The soil should be reasonably free from lumps, clods, and

trash, and should be moderately but not excessively loose. If a rotary tiller is used, the land should be prepared several days in advance to allow time to settle, or the soil should be compacted by rolling or in some other manner. For light sandy soils, such as those in Florida and other sections of the southern Coastal Plain, loosening by tillage is neither necessary nor desirable. The soil temperature should be above 50° F., preferably between 70° and 85°. The land should be fairly moist but dry enough to be tillable. Ample moisture is necessary if the fumigant is to be fully effective.

APPLYING THE FUMIGANT.—Fumigants are applied by placing small quantities in the soil about 6 inches beneath the surface, at intervals spaced 12 inches apart. To insure accurate spacing of the applications, the smoothed surface of the soil is marked lengthwise and crosswise with a row marker (fig. 5).

Figure 5.—Marking a seedbed for fumigation.

The fumigant can be applied by several methods. The most convenient for small areas is to punch a hole 6 inches deep at each point where the lines intersect, place a fumigant capsule in the hole, and cover it immediately with soil (fig. 6). Or the fumigant can be injected with any of the several forms of applicators on the market (fig. 7).

The furrow method of application is convenient and requires only improvised equipment. A furrow about 6 inches deep is opened and the fumigant poured into it from a fruit jar with two nail holes punched in the lid (fig. 8). The holes should be on opposite sides of the lid

near the edge, one hole for pouring the fumigant and the other providing access of air to the jar. The holes should be just large enough so that the amount of fumigant specified by the manufacturer is poured into each foot of furrow as the operator walks along at a steady pace. The correct hole size is determined by trials with a known quantity of water in the jar. The manufacturer usually will specify that a half pint of fumigant should be applied to a certain number of feet of row, so the size of the nail hole used for pouring is adjusted by trial until this amount of water is delivered. If it is specified that a

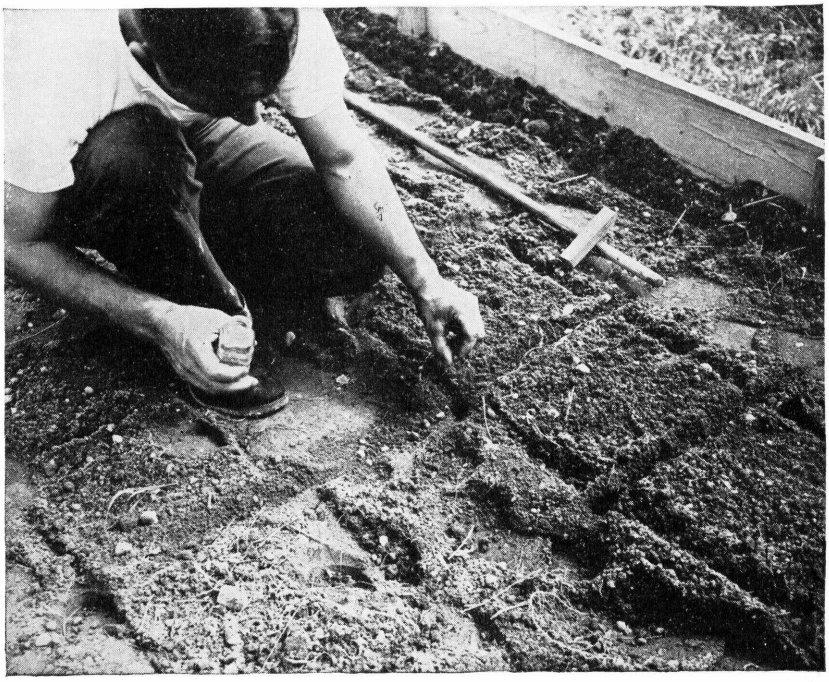

Figure 6.—Applying a soil fumigant in capsules. Holes are punched about 6 inches deep at the points where the marks intersect and one capsule is dropped into each hole.

certain number of cubic centimeters (cc.) or milliliters (ml.) be applied per foot of row, the number of feet per half pint can be calculated by dividing the specified number of cubic centimeters into 236 cc. (or ml.), which is the number of cubic centimeters in a half pint. After the nail holes of proper size have been punched in the jar lid, the jar is filled with fumigant, which is poured to the bottom of the furrow. The furrow is filled immediately; then a second furrow, 12 inches to one side and parallel to it, is opened. The application of the fumigant is repeated in this manner until the whole plot has been treated.

Granular materials may be distributed in furrows made as described for use of liquids, or placed in holes punched at 12-inch intervals with a stick as described for capsules. In either case, the application should be made at the rate recommended by the manufacturer, and the furrows or holes promptly filled.

Whatever the method used for applying the fumigant, the soil surface should be smoothed by raking when the application is finished. Results will sometimes be improved by sprinkling with water immediately after raking, just enough water being used so that it no longer soaks in readily.

Figure 7.—**Applying a soil fumigant with a hand applicator that injects a measured amount at a depth of about 6 inches.**

Circular areas from 4 to 6 feet in diameter, intended as planting sites for shrubs and trees, are fumigated in the same manner. For crops that are planted in widely spaced rows or hills, the fumigant can be applied only along the row or in the hill where the plants are to grow. Mark the position of the rows or hills. Make a single line of applications along each row at 12-inch intervals. If only one or a few plants are to be grown in each hill and the plants are to be grouped close together, make a single application in each hill. If the plants are to occupy an area 2 feet or so in diameter, make three applications in each hill, placing the applications in a triangular arrangement and spacing them 12 inches apart. Row fumigation has given satisfactory control of the root-knot nematodes and of the sting nematode, but it has failed to control the stubby-root nematodes.

Figure 8.—Applying a soil fumigant by pouring it from a fruit jar into a furrow. After application the furrow must be filled with soil immediately.

General Precautions

In using nematocides, the manufacturer's directions, as given on the container, should be followed exactly. While there is very little danger when nematocides are used properly, certain crops grow very poorly in soil treated with some nematocides. Also, it is possible that vegetables or fruit from plants grown on soil treated with nematocides may contain excessive amounts of deleterious substances derived from the nematocides. Crops on which the nematocide can safely be used and those on which it should not be used will ordinarily be specified on the label. Crop damage and residues in the produce will be increased if excessive amounts of nematocides are used. Accordingly, a nematocide should be used only on the crops and at the times and dosages specified on the manufacturer's label.

INTERVAL BEFORE PLANTING.—The interval that must elapse before it is safe to plant varies a great deal, depending on temperature, moisture, the kind of soil, and the rate of application. Fumigants linger in cold, wet soil and in soil having a large amount of organic matter. For most soils under average conditions and when the fumigant is applied at the rate suggested, it is usually safe to plant after 3 weeks. When the soil is light and sandy and conditions are hot and dry, an interval of 2 weeks or less may be adequate. When the soil is heavy and conditions are cool and wet, an interval of 4 weeks or even longer may be necessary. After the fumigant has been applied the soil should remain undisturbed for 1 week, but thereafter the escape of the gas can be hastened by tillage.

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